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Schmalz

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(54) **SINGLE STAGE SNOW THROWER WITH CO-ROTATING IMPELLER AND AUGER**

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(51) **Int. Cl.**
E01H 5/09 (2006.01)

(52) **U.S. Cl.**
CPC ***E01H 5/098*** (2013.01)

(58) **Field of Classification Search**
CPC E01H 5/045; E01H 5/098
See application file for complete search history.

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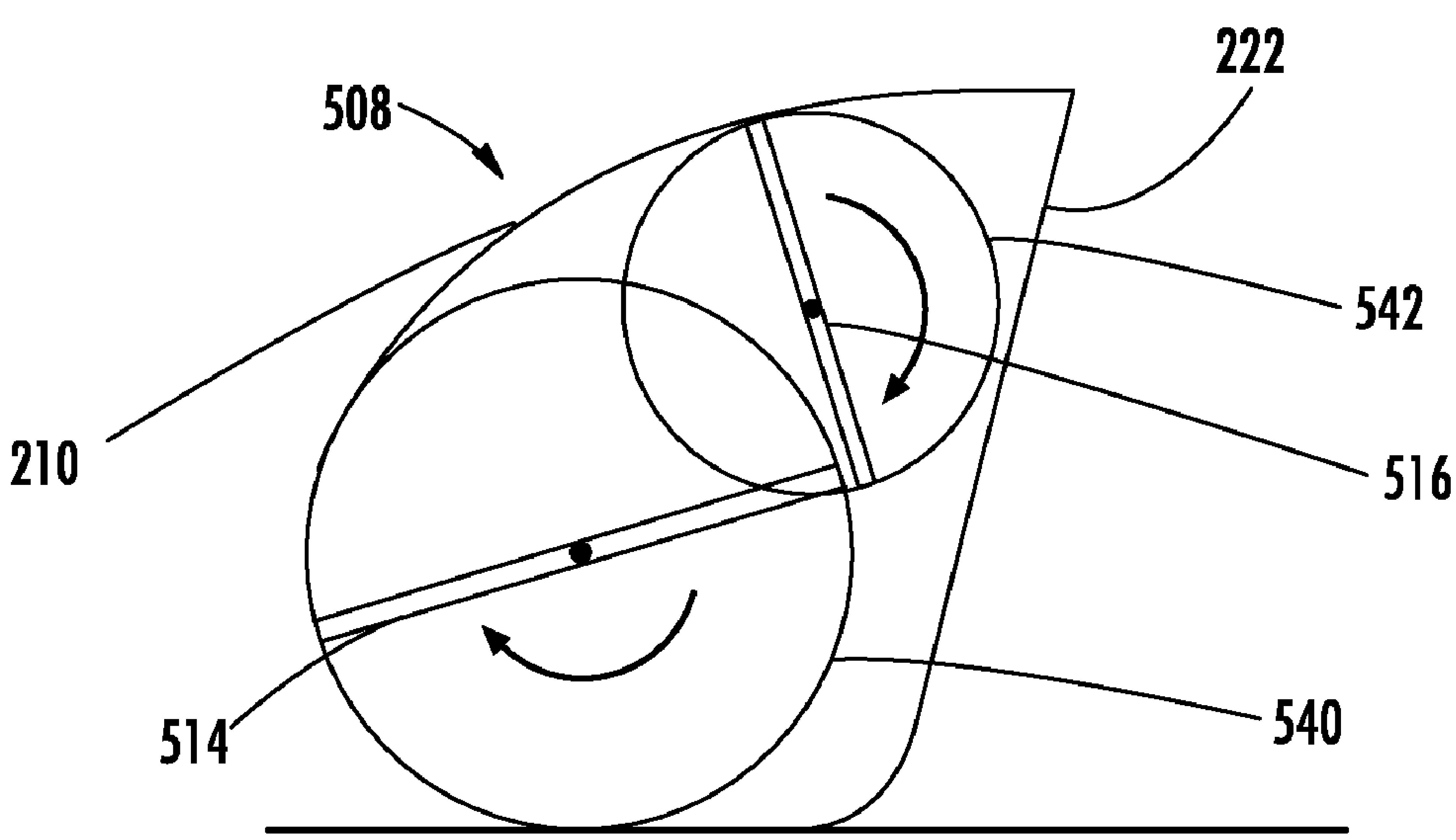
(57) **ABSTRACT**

A snow thrower head comprises an impeller and an auger disposed within a housing. The impeller is to contact a surface to be cleared by the impeller. The impeller is rotatable within the housing about a first axis while the auger is rotatable within the housing about a second axis above and forward the first axis.

26 Claims, 4 Drawing Sheets



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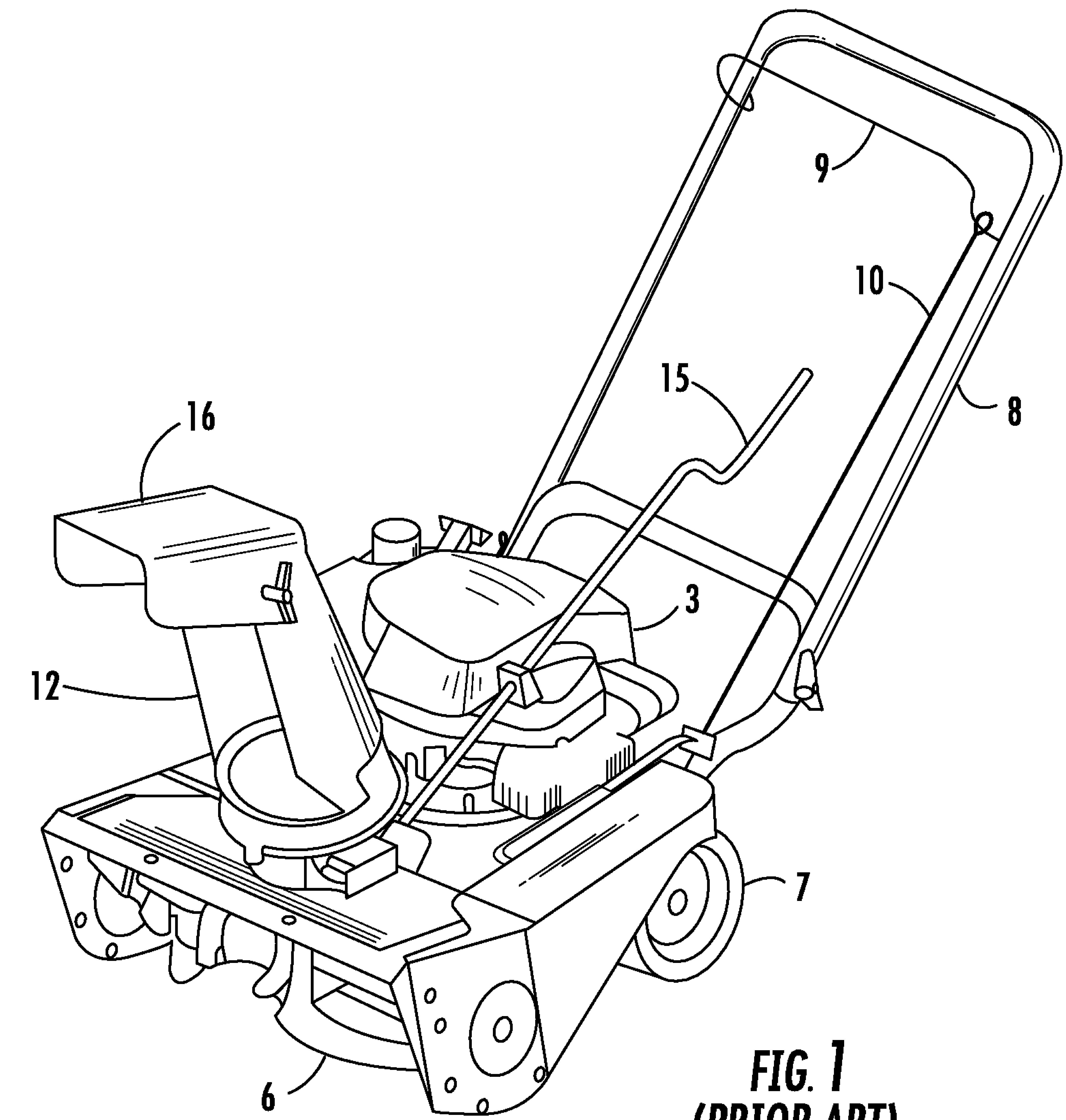

FIG. 1
(PRIOR ART)

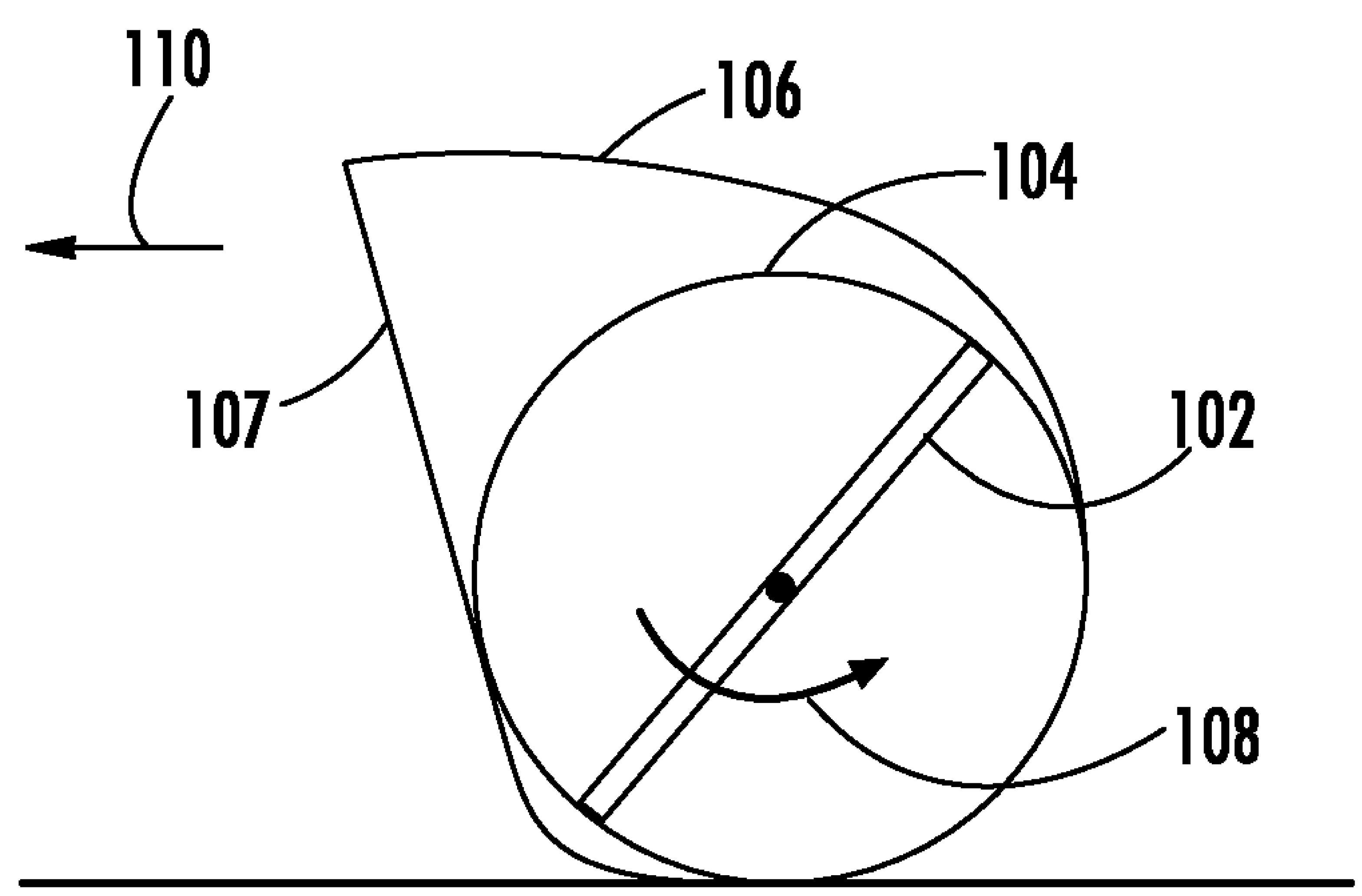

FIG. 2
(PRIOR ART)

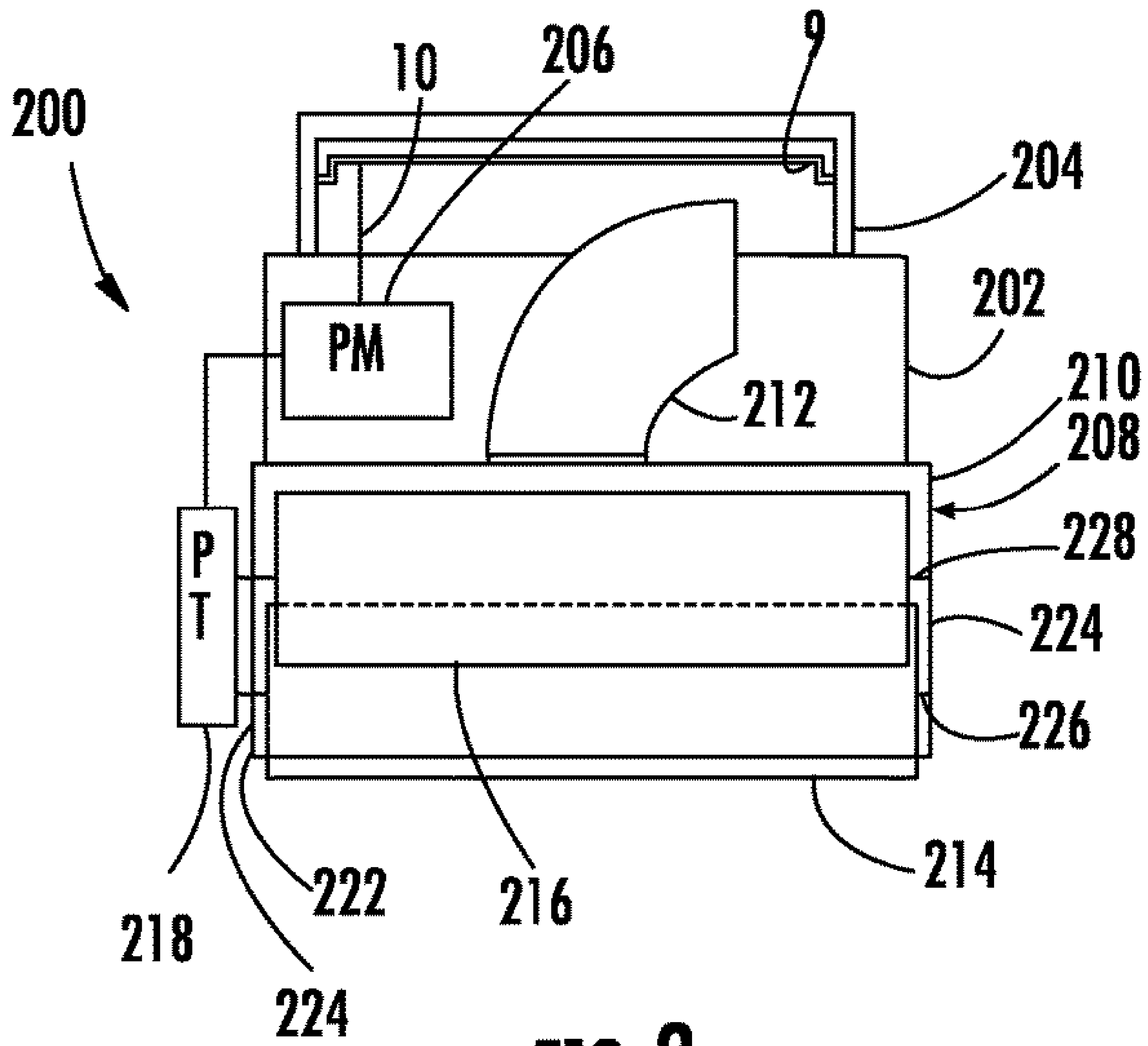

FIG. 3

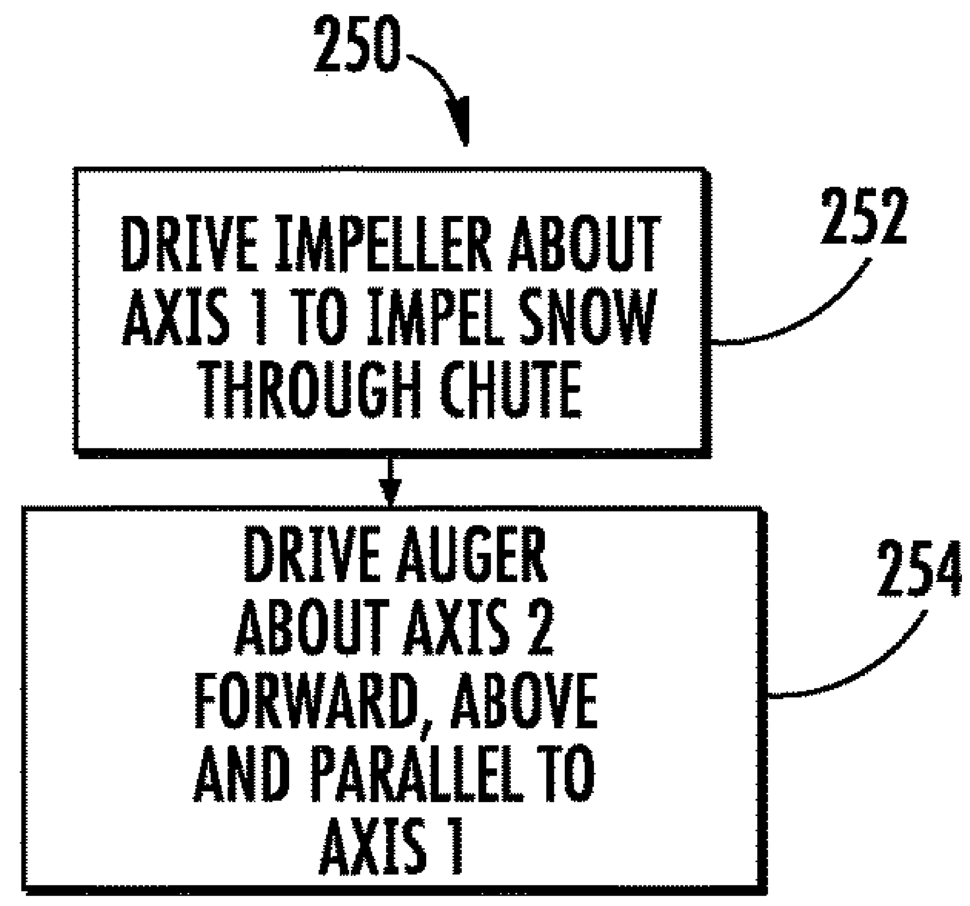

FIG. 5

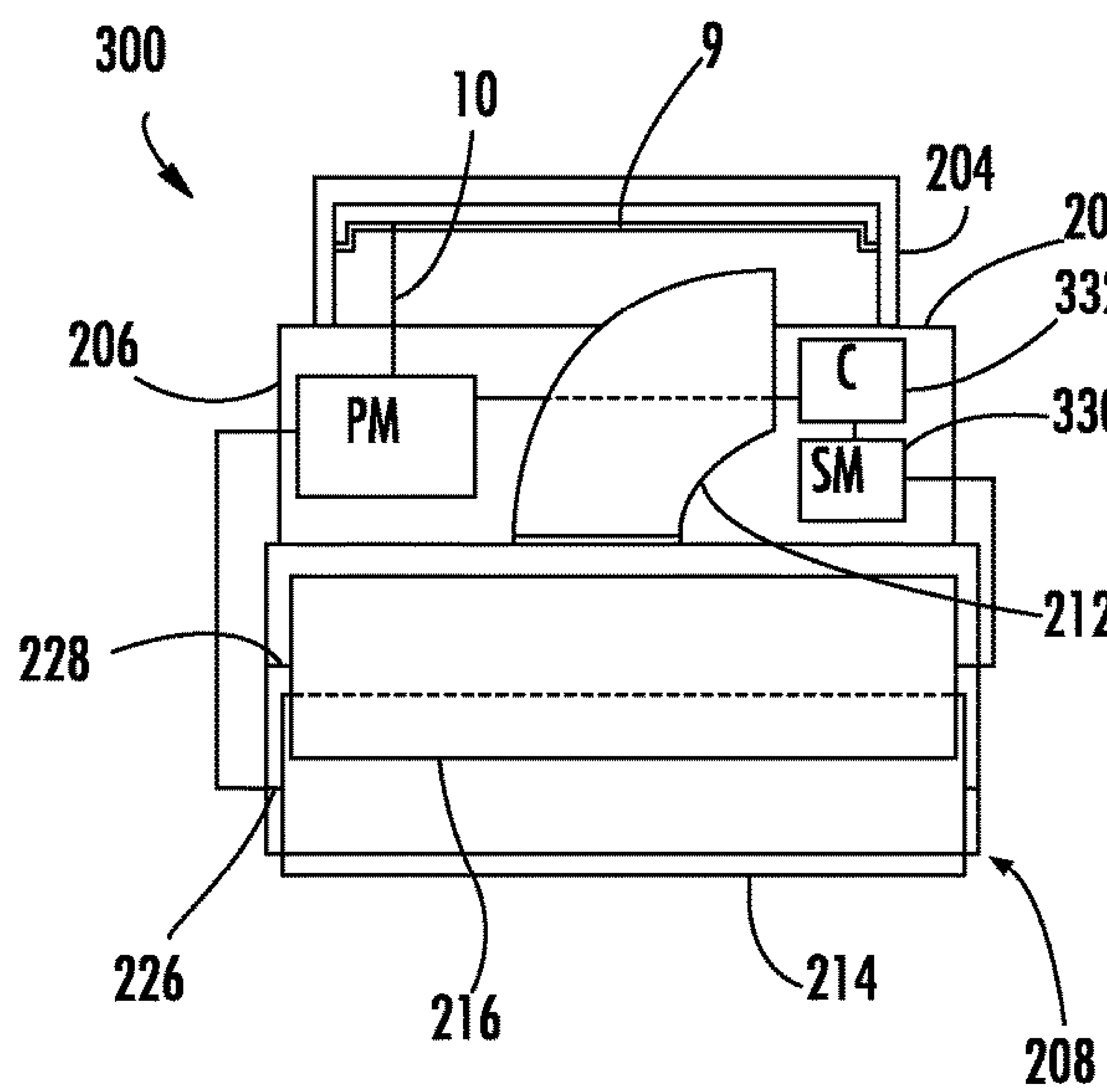

FIG. 4

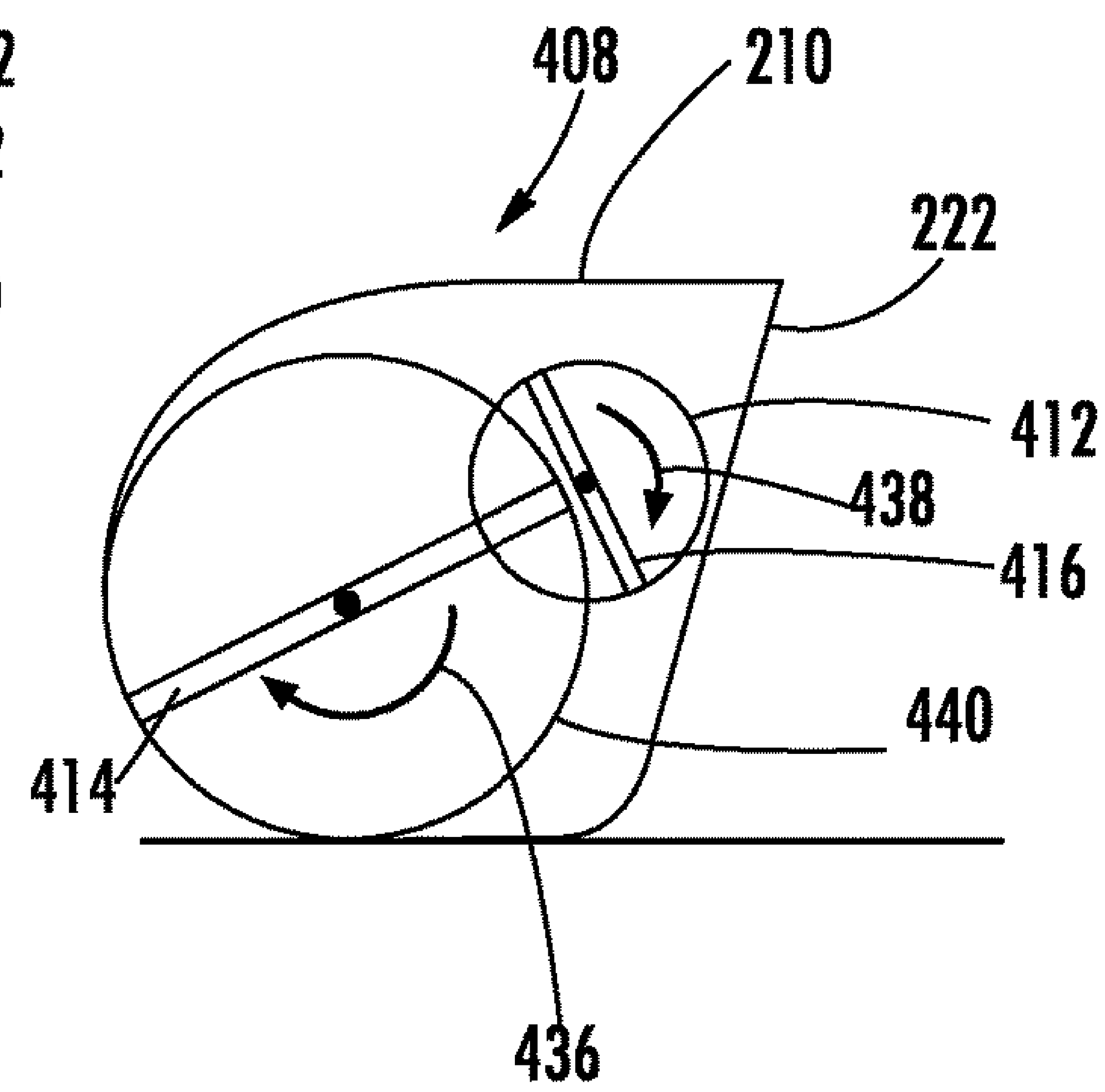

FIG. 6

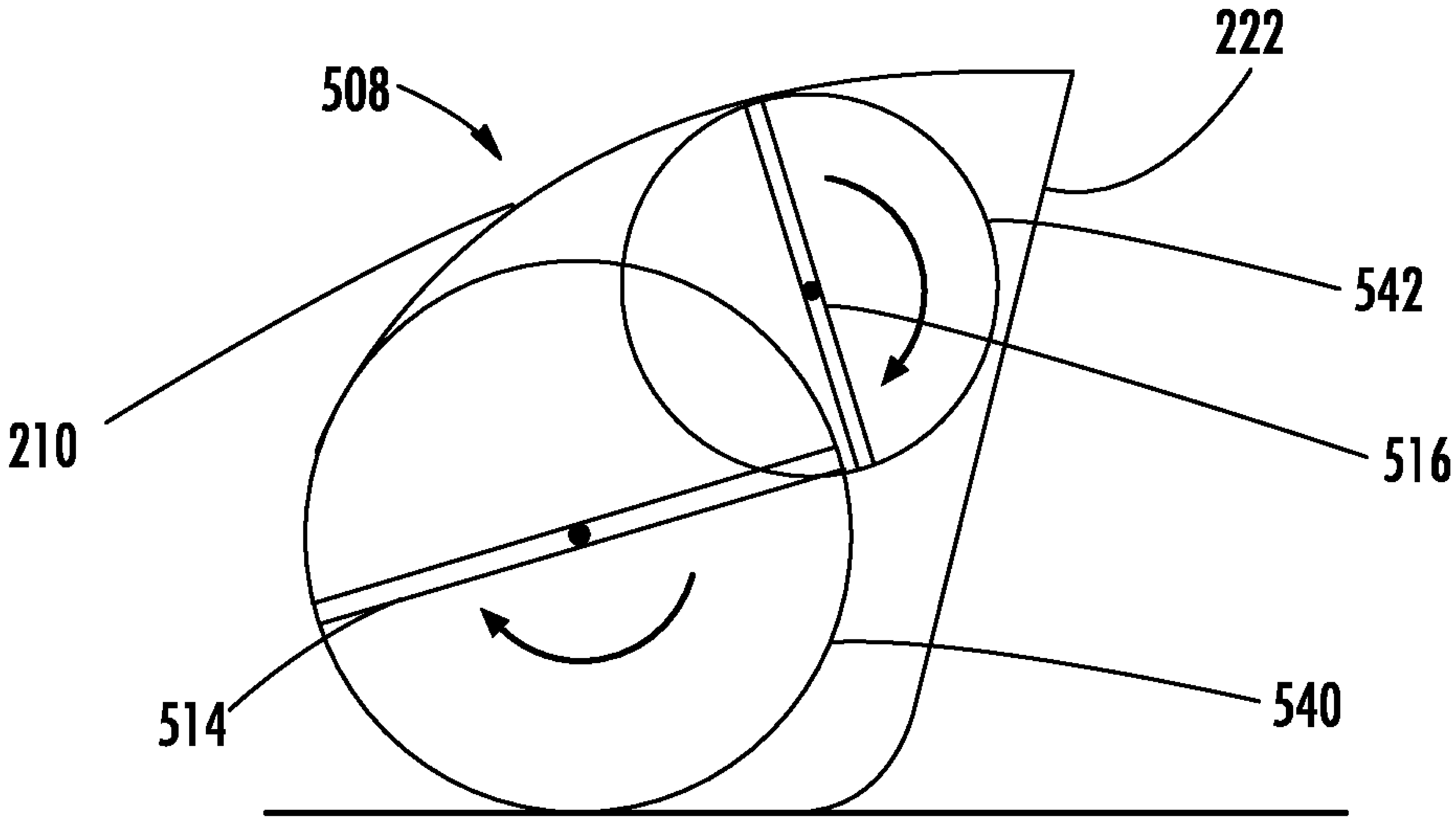

FIG. 7

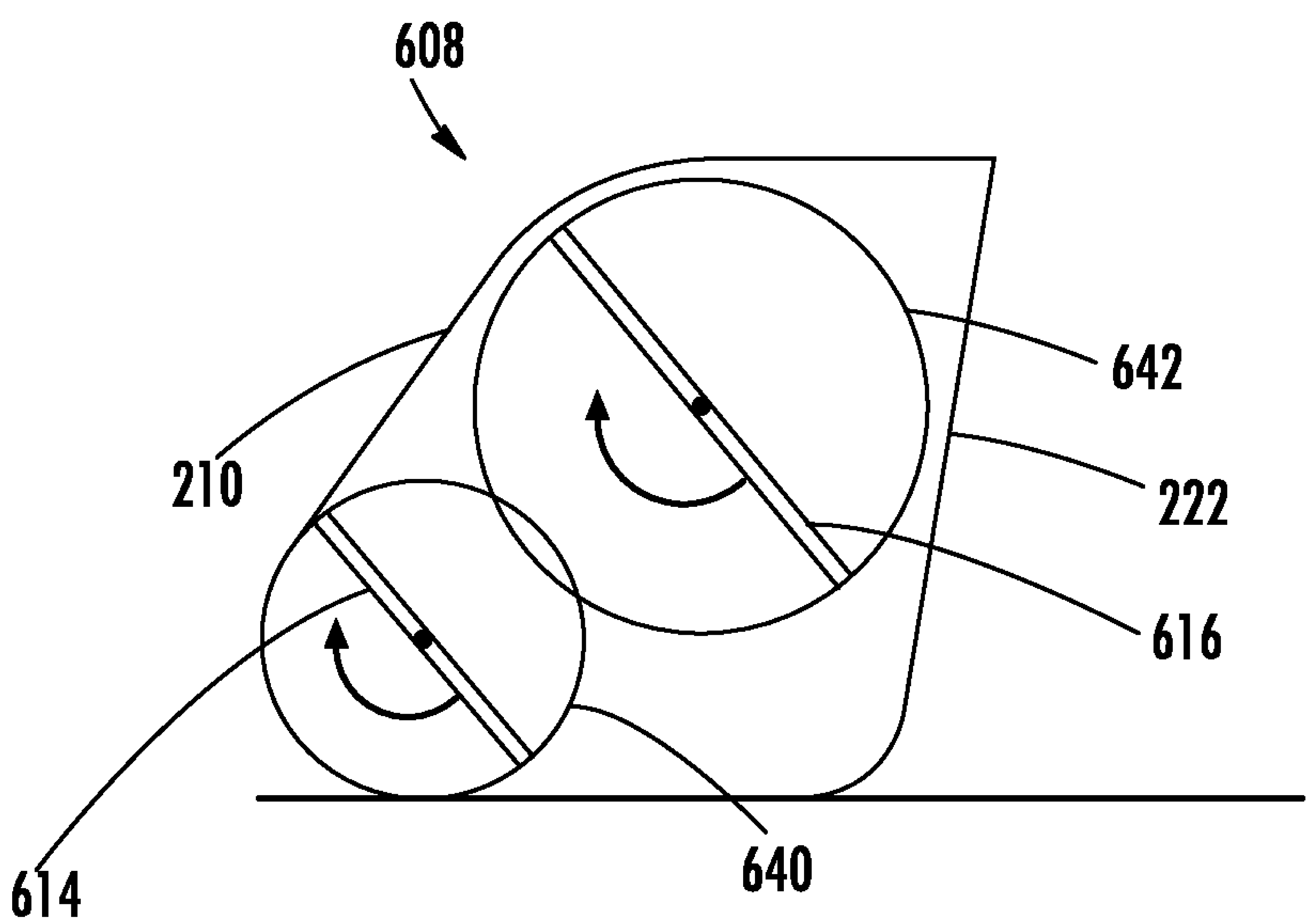

FIG. 8

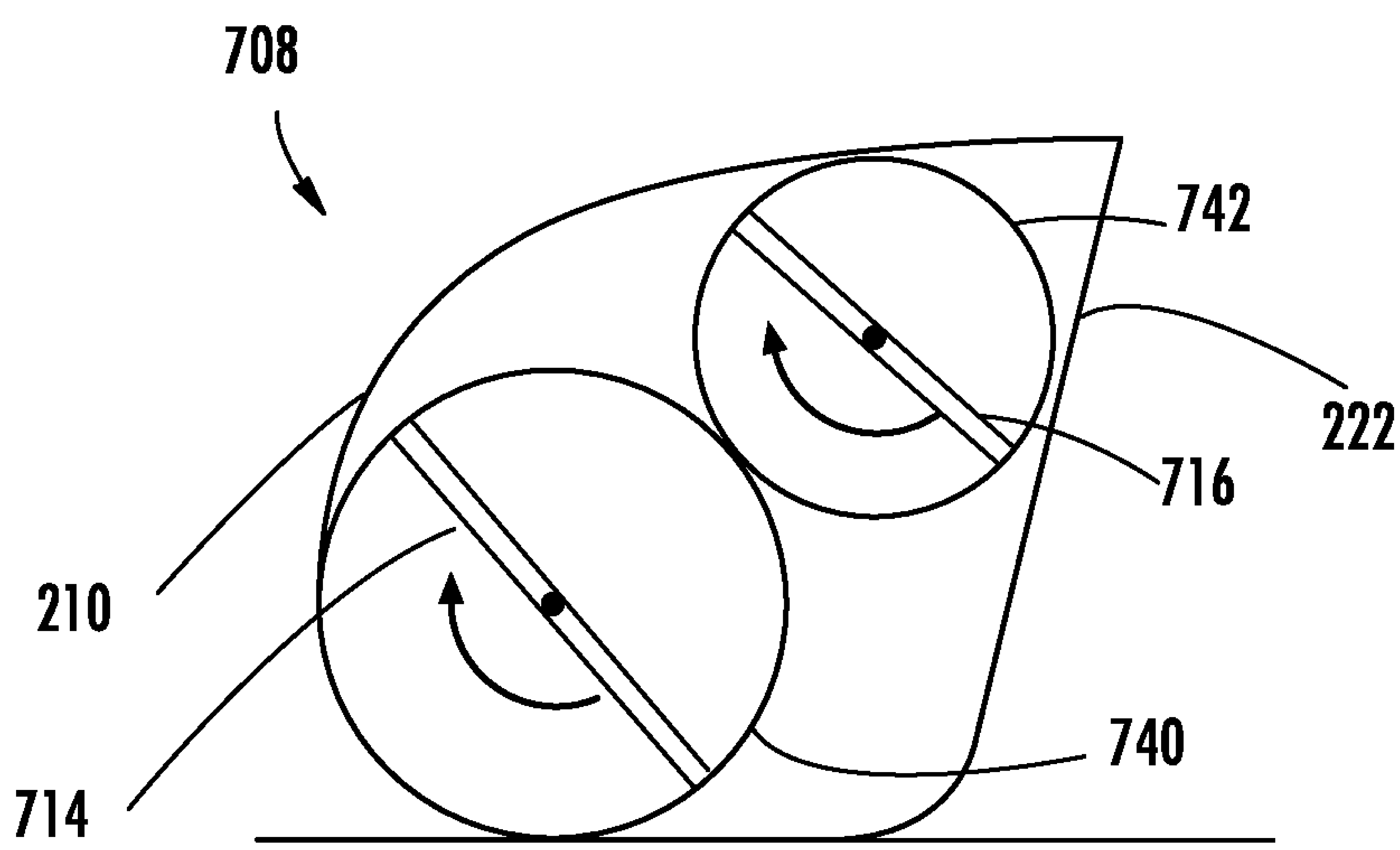

FIG. 9

SINGLE STAGE SNOW THROWER WITH CO-ROTATING IMPELLER AND AUGER

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

The present application claims priority under 35 USC 119 from U.S. Provisional Application Ser. No. 61/843,756 filed on Jul. 8, 2013 by Jacob J. Schmalz and entitled SINGLE-STAGE SNOW THROWER WITH CO-ROTATING IMPELLER AND AUGER, the full disclosure of which is hereby incorporated by reference.

BACKGROUND

The use of snow throwers (or snowblowers) by both commercial and residential operators is common for those located in snowy winter climates. These snow throwers may be walk-behind units or may be propelled by other machinery (e.g., all-terrain vehicles, tractors, etc.). Typically, snow throwers are divided into two categories: single-stage snow throwers and two-stage snow throwers. Single-stage snow throwers generally incorporate an impeller assembly that is driven by an internal combustion engine (or similar prime mover) to perform the functions of propelling the snow thrower forward, lifting snow from the surface to be cleared, and ejecting the snow out of a discharge chute. Alternatively, a two-stage snow thrower comprises a separate auger assembly and impeller assembly. Both the auger assembly and impeller assembly are driven by an internal combustion engine (or similar prime mover). The auger assembly rotates near the surface to be cleared in order to lift and direct snow and debris to the impeller assembly, which rotates along an axis perpendicular to the axis of rotation of the auger assembly. The impeller assembly then acts to eject snow out of a discharge chute.

In single-stage snow throwers, the impeller assembly is generally formed of a flexible material which contacts the surface to be cleared as it is directed along a path by the user. Due to this direct contact with the surface, single-stage snow throwers typically clear the entire surface of snow quite well. However, because the impeller assembly performs the tasks of propelling the snow thrower, lifting the snow, and ejecting the snow from the discharge chute, there are limitations to the size, shape, and material of the impeller assembly. These limitations reduce the effectiveness of the impeller assembly of a single-stage snow thrower in deep, icy, and/or heavy snow conditions.

On the other hand, two-stage snow throwers are generally more adept at clearing deep and/or heavy snow than their single-stage counterparts. This is because the auger assembly of two-stage snow throwers is typically formed of a rigid material (e.g., metal) that both separates and lifts the snow to be cleared and delivers it to the impeller assembly for ejection from the discharge chute. However, as the auger assembly is formed as a rigid, non-continuous component, the auger assembly is generally positioned within an auger housing so as to be a certain distance above the surface to be cleared. While in some ways it is advantageous for the rigid auger assembly to not contact the surface to be cleared, there is also the potential disadvantage of some snow being left behind and/or compacted as the snow thrower passes. Additionally, two-stage snow throwers are also generally much heavier and more costly than single-stage snow throwers.

Referring to FIG. **1**, a conventional assembly for a single-stage snow thrower is shown. An output shaft is connected to an impeller **6**, which is supported within a forward portion

of the housing by a drive connection. The rear portion of the housing is supported by wheels **7**. A handle **8** extends rearwardly of the housing. A control bar **9** is pivotally connected to the upper portion of handle **8** and is capable of being actuated by an operator. The control bar **9** is connected by a cable **10** to the drive connection between the engine's output drive shaft and the impeller **6**. During operation of the engine, the operator selectively actuates the control bar **9** to complete the drive connection between the engine and the impeller whereby snow is moved by the impeller **6** and is discharged from the housing through a discharge port provided in the housing above the central portion of impeller **6**. An adjustable discharge chute **12** is joined to the port to direct snow thrown by impeller **6**. A control rod **15** extends from one of its ends, positioned adjacent to handle **8**, to a worm gear (not shown) which is joined to the rod's opposite end. The worm gear is positioned in operative relationship with chute **12** to cause the chute to rotate about a vertical axis in response to actuation of control rod **15** to thereby control the direction of snow discharged from the snow thrower. The distance the snow is thrown is established by the position of a deflector **16** which is pivotally connected about a horizontal axis to the top of chute **12**.

Referring to FIG. **2**, a schematic side view of a conventional impeller and impeller housing assembly for a single-stage snow thrower is shown. The assembly comprises an impeller **102** coupled to a driven shaft (not shown) which rotates along a path **104** within impeller housing **106** having a mouth **107**. Impeller **102** operates to propel collected snow out of a discharge chute (not shown) of the snow thrower via flexible paddles formed of any suitable flexible material, e.g. rubber. Rotational path **104** has a diameter of about 10 inches, while housing **106** is shown as having a height of 12 inches and a depth of 12 inches. Impeller **102** is driven to rotate at a speed of about 1100 RPM. As impeller **102** rotates about path **104** in a direction indicated by arrow **108**, the flexible paddles of impeller **102** contact the surface to be cleared of snow to not only lift and propel the snow out of a discharge chute, but also to propel the snow thrower in a forward direction of travel as indicated by arrow **110**. However, as discussed above, icy or heavy snow is not readily broken down by impeller **102** alone, which may cause substantial clogging within the impeller housing and/or discharge chute.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an isometric view of a conventional single-stage snow thrower.

FIG. **2** is an schematic side view of a conventional single-stage snow thrower impeller assembly.

FIG. **3** is a schematic front view of an example single stage snow thrower of the present disclosure.

FIG. **4** is a schematic front view of another example single stage snow thrower of the present disclosure.

FIG. **5** is a flow diagram of an example method for clearing snow which may be carried out by the snow thrower of FIG. **3** or FIG. **4**.

FIG. **6** is a schematic side view of an example head of a single stage snow thrower.

FIG. **7** is a schematic side view of another example head of a single stage snow thrower.

FIG. **8** is a schematic side view of another example head of a single stage snow thrower.

FIG. **9** is a schematic side view of another example head of a single stage snow thrower.

DETAILED DESCRIPTION OF EXAMPLES

FIG. **3** is a front view schematically illustrating an example single stage snow thrower **200**. As will be described hereafter, snow thrower **200** utilizes an additional co-rotating auger, enhancing the ability of snow thrower **200** to handle icy or heavy snow conditions while effectively cleaning snow directly from the surface being cleared. Snow thrower **200** comprises frame **202**, handle **204**, prime mover **206** and head **208**.

Frame **202** comprises a foundational structure for snow thrower **200**. Frame **202** supports handle **204**, prime mover **206** and head **208**. In one implementation, frame **202** rotatably supports wheels, such as wheels **7** shown and described above with respect to FIG. **1**. In other implementations, frames **202** may comprise sleds that slide along the underlying terrain. Frame **202** may have a variety different sizes, shapes and configurations.

Handle **204** extends from frame **202** to facilitate manual maneuvering of snow thrower **200**. In one implementation, handle **204** is similar to handle **8** shown and described above with respect to FIG. **1**. In the example illustrated, handle **204** is additionally associated with control bar **9** and cable **10** described above with respect to FIG. **1**. Actuation of control bar **9** selectively engages and disengages either prime mover **206** or the operable coupling of prime mover **206** to head **208**. In other implementations, other control mechanisms and arrangements are utilized to allow an operator to selectively engage and disengage head **208**.

Prime mover **206** comprises a source of torque for rotatably driving components of head **208**. As will be described hereafter, prime mover **206** supplies torque for rotatably driving an auger and an impeller of head **208**. In one implementation, prime mover **206** comprises an internal combustion engine operably coupled to head **208** so as to supply torque to components of head **208**. In other implementations, prime mover **206** may comprise a source of power or torque, such as an electric motor powered by a battery or an electrical cord plugged into an electrical power source.

For purposes of this disclosure, the term "coupled" shall mean the joining of two members directly or indirectly to one another. Such joining may be stationary in nature or movable in nature. Such joining may be achieved with the two members or the two members and any additional intermediate members being integrally formed as a single unitary body with one another or with the two members or the two members and any additional intermediate member being attached to one another. Such joining may be permanent in nature or alternatively may be removable or releasable in nature. The term "operably coupled" shall mean that two members are directly or indirectly joined such that motion may be transmitted from one member to the other member directly or via intermediate members. For purposes of this disclosure, the phrase "configured to" denotes an actual state of configuration that fundamentally ties the stated function/use to the physical characteristics of the feature proceeding the phrase "configured to".

Head **208** comprises an assembly mounted to and supported by frame **202**. Head **206** is powered by prime mover **206** so to interact with snow and to propel or discharge snow to clear an area. In one implementation head **208** is releasably joined to frame **202** as an assembly or unit such that head **208** is removable as an assembly or unit while remaining intact for repair or replacement or for an upgrade to an existing snow thrower.

Head **208** comprises housing **210**, chute **212**, impeller **214**, auger **216** and powertrain **218**. Housing **210** comprises a partial enclosure extending about impeller **214** and auger **216**. In one implementation, housing **210** is C-shaped, having a mouth **222** facing in a forward direction, away from handle **204**. Housing **210** defines a single uninterrupted interior volume which contains both impeller **214** and auger **216**. In the example illustrated, housing **210** includes opposing sidewalls **224** which rotatably support end portions of axles **226**, **228** of impeller **214** and auger **216**, respectively, about rotational axes which are perpendicular and transverse to the forward direction.

Chute **212** extends upwardly from the interior of housing **210**. Chute **212** has an interior for directing and guiding snow propelled by impeller **214**. In one implementation, chute **212** is similar to chute **12** described above with respect to FIG. **1**. In one implementation, chute **212** additionally comprises deflector **16** and is actuatable to one of various snow directing positions by a control rod **15** (shown in FIG. **1**). In other implementations, chute **212** is fixed to direct snow to one side of snow thrower **200** in a sideways or transverse direction.

Impeller **214** comprises one or more paddles, blades or the like rotatably supported by axle **226** for rotation about an axis perpendicular and transverse to the forward direction. In one implementation, impeller **214** comprises one or more pairs of oppositely located paddles extending generally parallel to the rotational axis of axle **226**. In another implementation, impeller **214** comprises one or more helical paddles or blades helically extending about the rotational axis of axle **226**. In one implementation, impeller **214** is sized and is supported by housing **210** so as to reach into contact and engagement with the underlying terrain, facilitating the wiping, scraping or brushing of snow from the underlying terrain. In another implementation, impeller **214** is supported by housing **210** so as to extend into close proximity to the underlying terrain or just above (less than ½ inch above) the lower scraping edge of housing **210**.

In the example illustrated, impeller **214** has blades, paddles or the like that are formed from a flexible material, allowing the blades or paddles to resiliently flex when contacting the underlying terrain. In one implementation, impeller **214** has blades, paddles or the like formed from a material having an elastic modulus or modulus of elasticity (resistance to being deformed elastically, non-permanently) that is less than the elastic modulus of the material forming auger **216**. The lower elastic modulus of the blades or paddles of impeller **214** facilitates elastic deformation of such blades or paddles when scraping against the underlying terrain. In one implementation, impeller **214** has blades or paddles that are formed from a rubber or synthetic rubber.

Auger **216** comprises one or more paddles, blades or the like rotatably supported about an axis of axle **228**, parallel to the axis of axle **226** and perpendicular to the forward direction in which mouth **222** faces. In one implementation, auger **216** comprises one or more pairs of oppositely located paddles extending generally parallel to the rotational axis of axle **228**. In another implementation, auger **216** comprises one or more helical paddles or blades helically extending about the rotational axis of axle **228**. Auger **216** is rotatable about the axis of axle **228** forward and above the axis of axle **226**. As a result, auger **216** assists in directing deeper or higher snow into interaction with impeller **214**. Auger **216** further assists in breaking up ice or other hardened snow to reduce a likelihood of such hardened snow or ice clogging impeller **214** or discharge chute **212**.

In the example illustrated, auger **216** is stiffer or more rigid as compared to impeller **214**. As a result, auger **216** is better equipped to break up such ice or hardened snow, such as the crust of snow. In one implementation, auger **216** is formed from a material having an elastic modulus greater than the elastic modulus of the material from which the blade(s) or paddle(s) of impeller **214** are formed. In yet another implementation, the blade or paddles of impeller **214** and auger **216** are formed from similar materials, but the thickness and shape of auger **216** are chosen such that auger **216** has a greater bending stiffness as compared to the bending stiffness of the blades or paddles of impeller **214**. In one implementation, auger **216** is formed from an inflexible material, such as a metal, such as steel or aluminum.

As further shown by FIG. **3**, in the example illustrated, impeller **214** and auger **216** have blades or paddles that rotate in cylindrical or circular paths having outer diameters that intersect or overlap one another. As a result, auger **216** further facilitates the breakup of snow and the guiding of snow to impeller **214** for propulsion through discharge chute **212**. At the same time, the amount of additional spacer volume consumed by auger **216** is reduced, allowing the size of housing **210** and the weight of housing **2102** be reduced. In the example illustrated, the rotation of impeller **214** and auger **216** is timed relative to one another such that the blades and/or paddles of impeller **214** and auger **216** interleave with respect to one another during such rotation so as to not interfere with rotation of the other. In other implementations, impeller **214** and auger **216** are alternatively configured such that their blades or paddles and their circular paths do not overlap or intersect. Although impeller **214** and auger **216** are illustrated as rotating in circular paths having substantially the same size outer diameters, as will be described hereafter, in other implementations, the diameters of the circular paths may be different.

Powertrain **218** comprises a mechanism configured to receive torque or power from primary mover **206** and transmit such power to both impeller **214** and auger **216**. Powertrain **218** comprise a mechanism to operably link, through mechanical means, rotational speeds and relative positions of impeller **214** and auger **216**. Such operable linking of the rotation of impeller **214** and auger **216** results in auger **216** being rotatably driven at a speed that is dependent upon the speed at which prime mover **206** drives impeller **214**. In one implementation, such operable linking causes impeller **214** and auger **216** to be driven at the same rotational speed or revolutions per minute. In another implementation, such operable linking causes impeller **214** and auger **216** to be driven at different rotational speeds, wherein impeller **214** is driven at a speed directly proportional to, but less than or greater than, the speed at which the auger **216** is driven.

In one implementation, powertrain **218** is configured, such that impeller **214** and auger **216** are driven in the same direction about their axes. For example, both impeller **214** nor **216** are driven in a counterclockwise direction or a clockwise direction. In one implementation, powertrain **218** is configured such that impeller **214** and auger **216** are both driven in a direction such that a front portion of auger **216** rotates downwardly and rearwardly towards impeller **214** and such that a bottom portion of impeller **214** rotates upwardly and rearwardly to propel snow through chute **212**.

In another implementation, power train **218** is configured such that impeller **214** and auger **216** are driven in opposite directions about their axes. For example, while impeller **214** is driven in a clockwise direction, auger **216** is driven in a counterclockwise direction. For example, in one implementation, powertrain **218** is configured such that while the bottom portion of impeller **214** rotates upwardly and rearwardly to propel snow through chute **212**, the front portion of auger **216** rotates upwardly and forwardly. In implementations where impeller **214** and auger **216** are rotatably driven in opposite directions, an extent of overlap of the rotational paths of impeller **214** and auger **216** may be larger as compared to when impeller **214** and auger **216** are rotatably driven in the same direction.

In one implementation, powertrain **218** comprises a gear train operably linking rotational speed and relative positioning of impeller **214** and auger **216**. In another implementation, powertrain **218** comprises a belt and pulley arrangement or a chain and sprocket arrangement operably linking rotational speed and relative positioning of impeller **214** and auger **216**. Although illustrated as being part of head **208**, in other implementations, powertrain **218** is carried by frame **202** and is not part of the interchangeable head **208**.

FIG. **4** schematically illustrates snow thrower **300**, another implementation of snow thrower **200**. Snow thrower **300** is similar to snow thrower **200** except that snow thrower **300** omits powertrain **218** and additionally comprises secondary mover **330** and controller **332**. Those remaining components or elements of snow thrower **300** which correspond to components or elements of snow thrower **200** are numbered similarly or are shown in FIG. **3**.

Secondary mover **330** comprises a source of torque or power carried by frame **202** and operably coupled to auger **216**. Secondary mover **330** is configured to rotatably drive auger **216** about the axis of axle **228**. In the example snow thrower **300** shown in FIG. **4**, primary mover **206** is operably coupled to impeller **214** to rotatably drive impeller **214** about the axis of axle **226**. In one implementation, secondary mover **330** comprises a different source of power as compared to the source of power for primary mover **206**. For example, in one implementation, primary mover **206** comprises an internal combustion engine, wherein secondary mover **330** comprises an electric motor. In yet other implementations, both primary mover **206** and secondary mover **330** comprise similar types of sources of power. For example, in one implementation, both primary mover **206** and secondary mover **330** comprise electric motors or both comprise internal combustion engines.

Controller **332** comprises one or more processing units configured to control the operation of primary mover **206** and secondary mover **330** and/or the transmission of torque or power from primary mover **206** to impeller **214** and from secondary mover **330** to auger **216**. Controller **332** outputs control signals operably linking the rotational speeds at which impeller **214** and auger **216** are rotatably driven as well as the relative positions of the blade(s) or paddle(s) of impeller **214** and auger **216**. In one implementation, such control signals are transmitted to prime mover **206** and secondary mover **330** which control the output of primary mover **206** and secondary mover **330**. In one implementation where both primary mover **206** and secondary mover **330** comprise electric motors, such signals electrically control the output of such motors. In another implementation, such control signals cause one or more actuators, such as solenoids, pneumatic cylinder-piston assemblies or the like to control the output of internal combustion engines or to control/adjust positioning of components of the transmissions between primary mover **206** and impeller **214** and between secondary mover **330** and auger **216**.

For purposes of this application, the term "processing unit" shall mean a presently developed or future developed processing unit that executes sequences of instructions contained in a memory. Execution of the sequences of instructions causes the processing unit to perform steps such as generating control signals. The instructions may be loaded in a random access memory (RAM) for execution by the processing unit from a read only memory (ROM), a mass storage device, or some other persistent storage. In other embodiments, hard wired circuitry may be used in place of or in combination with software instructions to implement the functions described. For example, controller **332** may be embodied as part of one or more application-specific integrated circuits (ASICs). Unless otherwise specifically noted, the controller is not limited to any specific combination of hardware circuitry and software, nor to any particular source for the instructions executed by the processing unit.

In one implementation, controller **332** outputs control signals such that impeller **214** and auger **216** are driven in the same direction about their axes. For example, both impeller **214** nor **216** are driven in a counterclockwise direction or a clockwise direction. In one implementation, powertrain **218** is configured such that impeller **214** and auger **216** are both driven in a direction such that a front portion of auger **216** rotates downwardly and rearwardly towards impeller **214** and such that a bottom portion of impeller **214** rotates upwardly and rearwardly to propel snow through chute **212**.

In another implementation, controller **332** is configured to output control signals such that impeller **214** and auger **216** are driven in opposite directions about their axes. For example, while impeller **214** is driven in a clockwise direction, auger **216** is driven in a counterclockwise direction. For example, in one implementation, powertrain **218** is configured such that while the bottom portion of impeller **214** rotates upwardly and rearwardly to propel snow through chute **212**, the front portion of auger **216** rotates upwardly and forwardly. In implementations where impeller **214** and auger **216** are rotatably driven in opposite directions, an extent of overlap of the rotational paths of impeller **214** and auger **216** may be larger as compared to when impeller **214** and auger **216** are rotatably driven in the same direction. As a result, the space or volume consumed by impeller **214** and auger **216**, as well as the size of housing **210**, is reduced

FIG. **5** is a flow diagram of an example method **250** that may be carried out by either of snow throwers **200**, **300** or by other appropriately configured snow throwers. As indicated by block **252**, one or more torque sources, such as primary mover **206**, rotatably drive an impeller about a first axis to impel snow through a discharge chute. As indicated by block **254**, one or more torque sources, such as primary mover **206** or secondary mover **330** rotatably drive an auger about a second axis that is located forward and above the first axis. The first axis and the second axis extend parallel to one another, perpendicular to a forward direction in which a mouth of the snow thrower faces. In one implementation, the first axis and the second axis are located such that the paths of motion of the auger and the impeller have diameters that overlap or intersect one another.

FIG. **6** is a side sectional view of snow thrower head **408**, an example implementation of head **208**. Snow thrower head **408** may be utilized in either of snow throwers **200** or **300**. Snow thrower head **408** is similar to snow thrower head **208** except that snow thrower head **408** comprises impeller **414** and auger **416**. In the example illustrated, impeller housing **210** contains an impeller **414** which rotates about an axis perpendicular to the forward direction in which mouth **222** faces. Impeller **414** propels snow through discharge chute **212** shown in FIGS. **3** and **4**.

Impeller **414** is at least partially formed of a flexible material (e.g., rubber) to enable impeller **414** to contact the surface to be cleared for both snow removal and propulsion of the snow thrower in a forward direction. As illustrated, impeller **414** is rotatably driven about a path **440** in the direction indicated by arrow **436** at a speed of 1100 RPM and with a rotational diameter of 10 inches. Auger **416** is rotatably driven upon by prime mover **206** or by secondary mover **330** shown in FIGS. **3** and **4**, respectively, so as to rotate about a path **442** in the direction indicated by arrow **438**. Auger **416** may be constructed of any suitable material (e.g. steel, plastic, etc.).

Auger **416** is placed within impeller housing **210** such that auger **416** co-rotates with impeller **414** and the rotational path **440** of impeller **414** intersects with the rotational path **442** of auger **416**. For this co-rotation to occur successfully and without binding of the impeller and auger, auger **416** is sized appropriately (in this case, having a 5 inch diameter rotational path) and is driven at an appropriate speed (i.e., 1100 RPM). With this configuration, impeller **414** and auger **416** may rotate simultaneously to clear and throw snow.

Auger **416** enables the snow thrower to handle deeper snow than would otherwise be possible with impeller **414** alone. Additionally, auger **416** may act to break up hard-packed snow or ice that would otherwise be difficult for impeller **414** to penetrate. In this way, a single-stage snow thrower may incorporate the surface-cleaning benefits of an impeller-driven single-stage snow thrower with the heavy and deep snow removal benefits of an auger-driven dual-stage snow thrower.

FIG. **7** is a side sectional view illustrating snow thrower head **508**, another example implementation of head **208**. Snow thrower head **508** may be utilized in either of snow throwers **200** or **300**. Snow thrower head **508** is similar to snow thrower head **208** except that snow thrower head **508** comprises impeller **514** and auger **516**. In the example illustrated, impeller housing **210** contains impeller **514** which rotates about an axis perpendicular to the forward direction of travel of the snow thrower. Impeller **514** propels snow through discharge chute **212** shown in FIGS. **3** and **4**.

As shown by FIG. **7**, housing **210** partially surrounds impeller **514** and auger **516**. As with the configuration described above with respect to FIG. **6**, impeller **514** and auger **516** rotate simultaneously and have intersecting paths of rotation. Impeller **514** rotates at a speed of 1100 RPM and with a path **540** having a diameter of 10 inches. Auger **516** rotates at a speed of 1100 RPM and with a path **542** having a diameter of 7 inches. Auger **516** enables the snow thrower to penetrate deeper and/or more dense snow and works in concert with impeller **514** to efficiently clear and throw snow.

FIG. **8** is a side sectional view illustrating snow thrower head **608**, another example implementation of head **208**. Snow thrower head **608** may be utilized in either of snow throwers **200** or **300**. Snow thrower head **608** is similar to snow thrower head **208** except that snow thrower head **508** comprises impeller **614** and auger **616**. In the example illustrated, impeller housing **210** contains impeller **614** which rotates about an axis perpendicular to the forward direction of travel of the snow thrower. Impeller **614** propels snow through discharge chute **212** shown in FIGS. **3** and **4**.

Housing **210** is configured to partially surround and support impeller **614** that rotates along a path **640** at high rate of speed (e.g., 1650 RPM). Auger **616** rotates simultaneously along a path **642**. However, unlike the embodiments shown in FIGS. **6** and **7** above, impeller **614** has a rotational path diameter **640** smaller than that of auger **616**. For example, path **640** may have a 7 inch diameter, while path **642** may have a 10 inch diameter. Also, auger **614** is rotatably driven at a slower speed (e.g., 825 RPM) than impeller **616**, effectively increasing the torque that the auger can apply to break up condensed snow and ice. In this way, impeller **614** may act to clear snow from the surface and propel snow from the snow thrower, while auger **616** may act to pull in and break up deeper and more condensed snow within impeller housing **210**.

FIG. **9** is a side sectional view illustrating snow thrower head **708**, another example implementation of head **208**. Snow thrower head **708** may be utilized in either of snow throwers **200** or **300**. Snow thrower head **708** is similar to snow thrower head **208** except that snow thrower head **708** comprises impeller **714** and auger **716**. In the example illustrated, impeller housing **210** contains impeller **714** which rotates about an axis perpendicular to the forward direction of travel of the snow thrower. Impeller **714** propels snow through discharge chute **212** shown in FIGS. **3** and **4**.

Housing **210** is configured to partially surround and support impeller **714** that rotates along a path **740** at a high rate of speed (e.g., 1420 RPM). Auger **716** rotates simultaneously with impeller **714** along a path **742** with higher torque and a slower rate of speed (e.g., 355 RPM). In this embodiment, path **740** and path **742** do not intersect, but the operation of impeller **714** and auger **716** is still complimentary in that impeller **714** acts to clear the surface and light snow while auger **716** acts to break up condensed snow and break through deep snow to subsequently feed that snow to impeller **714** for propulsion out of housing **210**.

Although each of snow thrower heads **408**, **508**, **608** and **708** are illustrated as having their impellers and augers rotating in the same direction about their axes, in other implementations, the direction of rotation of the augers of each of such snow thrower heads **408**, **508**, **608** and **708** are reversed so as to rotate in opposite directions with respect to the impellers. Rotation of the augers in the same direction as the impellers facilitates movement of snow towards the impellers. Rotation of the augers in an opposite direction as the impellers facilitates a greater overlap of the auger with the impeller to reduce space consumption and the size of housing **210**.

While the preferred embodiments of the invention have been illustrated and described, it will be appreciated that various changes can be made therein without departing from the spirit and scope of the invention. For example, although different example embodiments may have been described as including one or more features providing one or more benefits, it is contemplated that the described features may be interchanged with one another or alternatively be combined with one another in the described example embodiments or in other alternative embodiments. One of skill in the art will understand that the invention may also be practiced without many of the details described above. Accordingly, it will be intended to include all such alternatives, modifications and variations set forth within the spirit and scope of the appended claims. Further, some well-known structures or functions may not be shown or described in detail because such structures or functions would be known to one skilled in the art. Unless a term is specifically and overtly defined in this specification, the terminology used in the present specification is intended to be interpreted in its broadest reasonable manner, even though may be used conjunction with the description of certain specific embodiments of the present invention.

What is claimed is:

1. A single-stage snow thrower comprising:
- a prime mover;
- a discharge chute;
- a housing defining a volume, the volume comprising a portion contained underneath the discharge chute, the housing further defining a forward opening in front of and transversely extending across the portion of the volume and through which snow may pass into the portion of the volume;
- an impeller disposed within the portion of the volume of the housing underneath the discharge chute, the impeller operably coupled to the prime mover and rotatable within the housing about a first axis;
- an auger disposed within the housing in front of the discharge chute and rotatable within the housing about a second axis parallel to, above and forward the first axis.

2. The snow thrower of claim **1**, wherein the impeller has a first rotational path and wherein the auger has a second rotational path differently sized than the first rotational path.

3. The snow thrower of claim **2**, wherein the first rotational path is larger than the second rotational path.

4. The snow thrower of claim **2**, wherein the first rotational path is smaller than the second rotational path.

5. The snow thrower of claim **1**, wherein impeller has a first rotational path and wherein the auger has the second rotational path, wherein the first rotational path and the second rotational path intersect.

6. The snow thrower of claim **1**, wherein the prime mover is operably coupled to the auger so as to rotatably drive the impeller and the auger.

7. The snow thrower of claim **6** further comprising a power train operably linking the auger and the impeller such that the prime mover rotatably drives the auger at a first speed dependent upon a second speed at which the prime mover drives the impeller.

8. The snow thrower of claim **7**, wherein the second rotational speed is less than the first rotational speed.

9. The snow thrower of claim **8**, wherein the impeller has a first rotational path and wherein the auger has a second rotational path larger than the first rotational path.

10. The snow thrower of claim **1** further comprising a secondary mover operably coupled to the auger to rotatably drive the auger, wherein the primary mover comprises a first internal combustion engine or a first electric motor and wherein the secondary mover comprises a second internal combustion engine or a second electric motor.

11. The snow thrower of claim **10**, wherein the prime mover and the secondary mover are operably linked such that the secondary mover rotatably drives the auger at a first speed based upon a second speed at which the primary mover rotatably drives the impeller.

12. The snow thrower of claim **11**, wherein the impeller has a first rotational path and wherein the auger has a second rotational path larger than the first rotational path and wherein the first speed is less than the second speed.

13. The snow thrower of claim **10** comprising a controller operably linking operation of the prime mover and the secondary mover.

14. The snow thrower of claim **1**, wherein the impeller comprises a flexible blade.

15. The snow thrower of claim **14**, wherein the flexible blade comprises rubber.

16. The snow thrower of claim 14, wherein the auger comprises a first blade formed from a first material having a first elastic modulus and wherein the impeller comprises a second blade formed from a second material having a second elastic modulus less than the first elastic modulus.

17. The snow thrower of claim 1, wherein the housing comprises opposite side walls rotatably supporting a first axle of the impeller and a second axle of the auger.

18. The snow thrower of claim 1 comprising rotatable snow engaging and driving members consisting of the impeller and the auger.

19. The snow thrower of claim 1, wherein the impeller comprises a paddle supported and rotatably driven to lift snow off of the underlying terrain and to impel the snow directly into the discharge chute.

20. The snow thrower of claim 1, wherein the prime mover is operably coupled to the impeller to drive the impeller in a same direction about the first axis as the auger is driven about the second axis.

21. The snow thrower of claim 1, wherein the auger comprises oppositely located paddles extending parallel to the second axis.

22. A snow thrower header comprising:

a housing;

a discharge chute extending from the housing;

an impeller underneath the discharge chute and disposed within the housing so as to contact an underlying terrain to be cleared by the impeller, the impeller rotatable within the housing about a first axis to lift snow from the underlying terrain and impel the snow directly into the discharge chute;

an auger disposed within the housing and rotatable within the housing about a second axis above and forward the first axis.

23. The snow thrower header of claim 22, wherein the housing defines a volume having a portion directly below the discharge chute and a forward opening in front of the portion of the volume through which snow may pass into the portion of the volume and wherein the auger is disposed within the housing in front of the discharge chute.

24. The snow thrower of claim 22, wherein impeller has a first rotational path and wherein the auger has the second rotational path, wherein the first rotational path and the second rotational path intersect.

25. A method comprising:

rotatably driving an impeller underneath a discharge chute about a first axis and in direct contact with terrain underlying snow to be lifted from the underlying terrain and to directly impel the snow into and through the discharge chute; and

rotatably driving an auger about a second axis parallel to, above and forward the first axis to move the snow towards the impeller.

26. A single-stage snow thrower comprising:

a prime mover;

a housing;

a discharge chute;

an impeller disposed within the housing underneath the discharge chute, the impeller operably coupled to the prime mover and rotatable within the housing about a first axis;

an auger disposed within the housing and rotatable within the housing about a second axis parallel to, above and forward the first axis, wherein the housing has opposing side walls, the housing defining a single uninterrupted interior volume containing both the impeller and the auger, wherein the auger overlies a continuous uninterrupted empty volume bounded by a bottom of the auger, a front of the housing and a front of the impeller.

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